

Exterior and Interior
Photography

INCORPORATION
OF ARCHITECTS
IN SCOTLAND

*Sir Rowand Anderson
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AN INTERIOR.

[Frontispiece.

EXTERIOR AND INTERIOR PHOTOGRAPHY,

BY

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AUTHOR OF

“THE ART AND PRACTICE OF INTERIOR PHOTOGRAPHY,” “PHOTOGRAPHY
FOR ARCHITECTS,” “PHOTOGRAPHY APPLIED TO THE MICROSCOPE,”
“AN INTRODUCTION TO THE STUDY OF THE DIATOMACEÆ,”

ETC.

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PREFACE.

AT the suggestion of the Publishers the following pages have been written instead of revising *The Art and Practice of Interior Photography*, which was published five years ago, and has been out of print for some time. Much has been written during the past few years on the artistic treatment of landscape photography but the treatment of architectural subjects, both exterior and interior has been neglected.

John Ruskin pointed out, in *The Stones of Venice*, the great assistance which the science of photography might render to the architect, in the accurate reproduction, within certain limits, of architectural details. It is curious that this observation from so great an authority has not led more students of architecture to practice photography, and more photographers to pursue this branch of their science. It is probable, however, that the want of information, and the difficulty of obtaining satisfactory instructions, has hindered many from attempting this class of subject.

Many excellent papers have been read, and articles contributed to periodicals, but these could not be made available to the ordinary worker without much research.

It is therefore hoped that this brief treatise, which presents practical information in a concise form, may supply a want.

J. W. Mills

Thornleigh, Huddersfield,
April, 1895.



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An Interior. This illustrates the most ordinary type of interior subjects. The markings on the blue china have been thoroughly brought out by means of an isochromatic plate in conjunction with a light yellow screen (Ilford No. 1) *Frontispiece.*

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Titchfield Castle. This print, as an example of lighting, is intended to illustrate the successful rendering of an architectural subject, the correct time of day being chosen 19

The Nave, York Minster. It will be observed that the position of the organ has been taken advantage of, so as to almost cover the east window, which was too brilliant a subject to risk with an unbacked plate 27

EXTERIOR AND INTERIOR PHOTOGRAPHY.

CHAPTER I.

APPARATUS.

THE apparatus necessary consists of a camera, tripod, lenses, and the usual accessories.

The camera should possess a rising front, having a lateral sliding motion and forward swing, held firm by slotted metal struts, a reversing back capable of swinging laterally as well as forward and backward, the axes of both movements crossing in the centre of the focussing screen. The back should be capable of being pushed forward towards the front of the camera, as shewn in the accompanying illustration, to

enable the operator to use a short focus lens without the foreground of the picture being cut off by the bottom board, which would be the case if the front were drawn towards the back of the camera.

The dark slides should be fitted with bayonet joints, in order to lessen the danger of rotating the camera upon the tripod when sliding them into position.

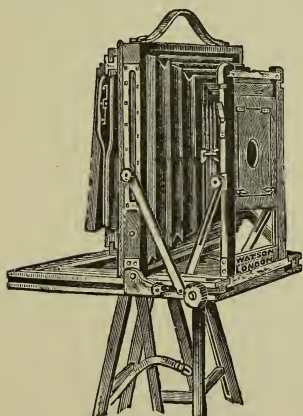


FIG. 1.

The reversing back should be capable of attachment to the camera when any of its four sides are placed at the top, so that the shutters of the dark slides may be drawn out from either side, or from the top or bottom. This point is seldom provided for by a camera manufacturer.

The focussing screen should be ruled, with a fine pointed lead pencil, from side to side, and from end to end, with parallel lines one inch apart, dividing the field into a number of squares. Such lines will prove very useful when focussing the object, and arranging the vertical and horizontal lines in their directions upon the screen.

The bellows should not taper to the front of the camera too rapidly or a portion of the image will be cut off by their interposition between the lens and the plate. A tab attached to the centre of the bellows which can be passed over a small button or screw placed upon the top of the camera, will be found useful when working with a short focus lens, and will prevent the inconvenient dip of the bellows. The rising front carrying the lens should also carry with it the bellows, when raised and lowered, and be moveable up and down and from side to side over at least one third of the largest size of plate taken by the camera. The lens-board should be detachable so that the isochromatic-screen may be easily placed behind the lens.

The tripod must be firm, the bottom joint of each of the legs being made to slide. It may be fastened to the camera by a screw, or better by a rotating turntable let into the bottom board of the camera. Most tripods are not tall enough to hold the camera with the lens at the same height as the line of vision. The importance of having the camera placed at the proper height is rendered apparent by carefully noticing the perspective of an interior, while standing upright and while sitting down. The vanishing points vary considerably in these two positions.

Unfortunately it is almost always necessary to use lenses for architectural and interior photography of comparatively short focus, so as to include in the image as much of the subject as possible. This is particularly the case with interiors and generally so with the exteriors of buildings. It is often impossible to get far enough away from the subject to allow of the use of a narrow angled lens.

The lenses most useful for the work under consideration are such as have their focal length not exceeding the length of the base of the plate to be exposed. Those known as anastigmatic or apochromatic give a flatter field over a larger area than ordinary rectilinears. All lenses should be fitted with the standard thread of the Royal Photographic Society of Great Britain, so that they may be interchanged, in the same flange attached to the front of the camera. The smaller lenses fit into the flange of the larger by means of standard adapters, also bearing the Society's standard thread.

It is important that the inside of the lens mount and also the leaves of the iris diaphragm, or stops, should be dull black, otherwise reflections may spoil the negative.

The inside of the mounts may be re-blackened, when necessary, by painting them with a mixture of lamp black made into a paste by adding methylated spirit and a *very* small quantity of gum arabic dissolved in water. This paint will dry very rapidly in a warm atmosphere, and will not give off any fumes which can injure the glass of the lens. Diaphragm leaves, or stops, when they have become bright with wear, may be blackened by painting them with a hot saturated solution of washing soda in water. They should be dried by heat, and then painted with a strong solution of potassium sulphide.

A yellow isochromatic screen of glass, the sides of which are perfectly flat and parallel, will be found necessary to correct the unequal colour sensitiveness of the plates. The

Ilford No. 1 screen will answer most purposes. The screen should be fitted inside the camera, and of a larger size than the aperture of the lens flange, as the rays projected from a short focus lens diverge in a wide angle towards the edges of the plate.

A spirit level is a *sine qua non*. It should be a small carpenter's level, not a circular one as usually supplied by photographic opticians. Balance levels attached to the sides of the swing-back, or tilting-front, are liable to catch the focussing-cloth and be sprained. They are usually too light to move with the slightest displacement of the swing-back, or front, and for this reason should not be relied upon. A watch held at the end of a chain, or a weight attached to a piece of string will better answer the same purpose, besides being far more easily employed than any small fanciful article fixed to the camera.

The focussing-cloth should be very large and thick, and have several tapes sewn on to it, so that it may be tied over the camera in any manner desired. The tapes should be of a different colour to the cloth, to render them more visible.

A large focussing glass will be found very useful, as the image of an interior on the focussing-screen is often so dim, that without its aid, it is difficult to see accurately to adjust the focus.

Three small balls of india-rubber, each provided with a hole, into which the spikes of the tripod may be inserted, will prevent the camera slipping on a smooth surface.

A Watkins' Exposure Meter is of great value in estimating the exposures, not only of interiors, but of exteriors. The human eye adapts its iris to varying intensities of light by increasing the aperture when the light is weak, and decreasing it when the light is more intense, thus equalising the visual intensities. It will, therefore, be understood that intensities of light varying in brilliancy after passing through

the iris lose their relative visual values before striking the retina. An exposure meter, is capable of accurately measuring the actinic ratio of light, which cannot be gauged by the eye.

The size of the apparatus depends much upon the requirements of each individual, but it may be taken as a general rule, unless lantern slides are desired, that the camera should take plates at least 10 in. by 8 in.; larger sizes than this being advantageous. Of course, in large sizes weight has to be considered, but, with serious work in view, this should be a secondary consideration.

CHAPTER II.

LIGHT AND COLOUR.

SUNLIGHT is either emitted, reflected, or transmitted. Light is termed emitted when thrown out from a luminous body, reflected when the luminous rays after falling upon an object are all or a portion of them reflected thus rendering that object (being other than a luminous body) visible, and transmitted when rays of light pass through a more or less transparent substance. It is not intended here to enter into the abstruse theory as to what light is, or how it is made to vibrate through space, but to give a short explanation as to its composition so far as the same bears upon the practice of photography.

White light is composed of a number of rays varying in refrangibility and the length of their vibrations. Each of these rays, which are visible to the eye, are of a different colour according to the length of their vibrations, and may be demonstrated by passing a beam of sunlight through a prisim of glass, or other transparent medium, as shewn in Fig. 2.

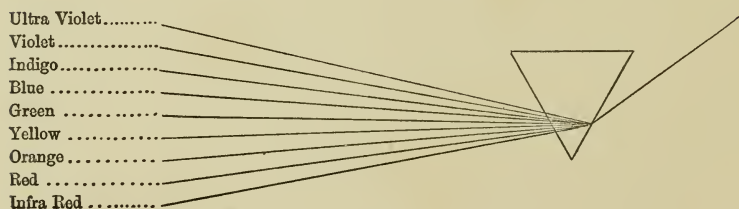


FIG. 2.

These colours do not all appear equally bright to the eye, and in fact those at either extreme of the spectrum, viz. : the

ultra violet and the infra red rays are invisible. The following table is calculated by Professor Rood from his own measurements of the quantity of the various colours of the spectrum and Vierordt's measurements of their relative brightness. It gives the quantities of light of various colours in 1,000 parts of white sunlight.

Red	54	Yellowish-green	121
Orange-red	140	Green and blue-green ..	134
Orange	80	Cyan blue	32
Orange-yellow	114	Blue	40
Yellow	54	Ultramarine and blue-violet	20
Greenish-yellow	206	Violet	5

Professor Rood has also determined the brightness of different parts of the spectrum to the eye, and arrived at the following table as expressing numerically the relative luminosities of the several spectrum colours, *i.e.*, their relative brightness of the human eye.

Dark red	80	Greenish-yellow, yellow- green, and green ..	3933
Pure red	493	Blue-green and cyan blue..	1100
Red	1100	Blue	493
Orange-red	2773	Ultramarine	90.6
Orange and orange-yellow	6985	Blue-violet	35.9
Orange-yellow	7891	Violet	13.1

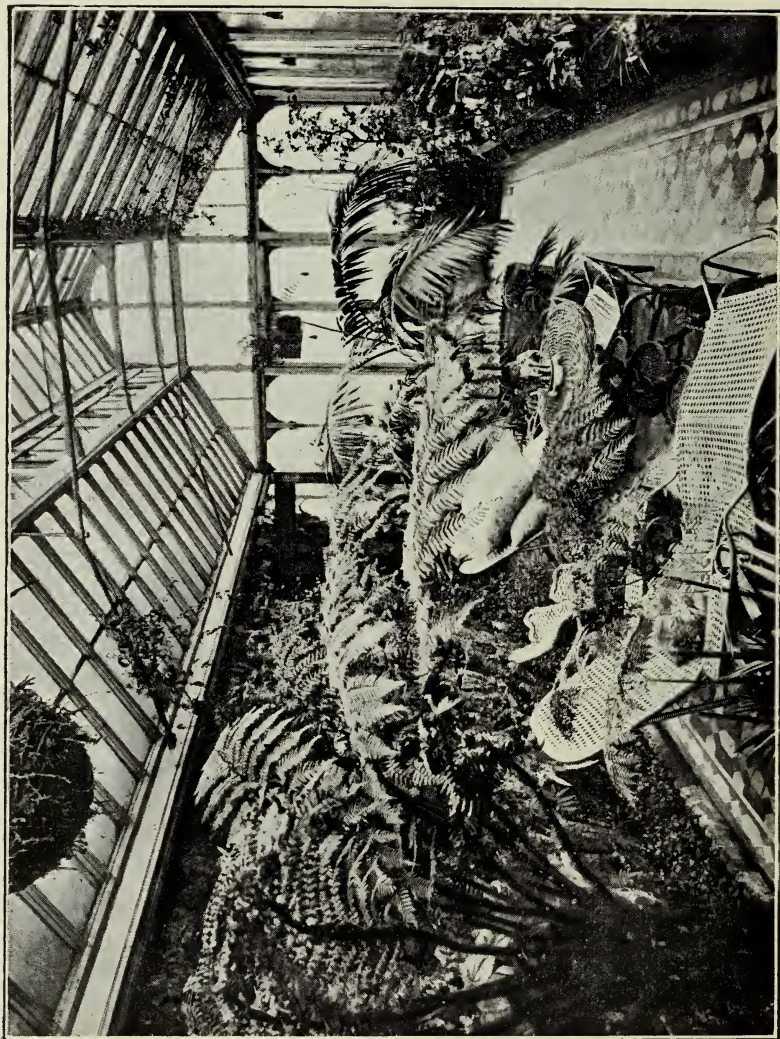
When consulting the above tables it must be remembered that the apparent brightness of the several colours of the spectrum relatively varies as the original beam of light varies in intensity. The eye being very sensitive to blue in a weak light, and to yellow in a strong light. This is why moonlight appears blue and sunlight yellow.

We have now seen that the eye is more sensitive to some colours than others. This is also the case with regard to the photographic plate, but unfortunately for the photographer there is a very wide discrepancy between the two. Not only do each of the rays, having a different length of

vibration, exert various intensities of action upon the plate, but some of them do not exert any action whatever. The force or influence that causes photo-chemical action is termed actinism, and the rays which are capable of exerting this influence, actinic.

The actinic rays are situated at the more refrangible end of the spectrum—the violet end. The red and orange rays are not actinic and the yellow but very slightly so on an ordinary* photographic plate. If such a plate be exposed upon the solar spectrum it will be seen how different the two ends of the spectrum are in their actinic power. Violet and blue will give very pronounced impressions, each of the coloured rays will decrease in their actinism as they approach one by one towards the red end of the spectrum. On referring to the second of Professor Rood's tables given above it will be seen that the blue-violet and violet rays are the least visible, and as these are the most actinic of all the rays of the spectrum, the photographic image, unless chromatically controlled, will be extremely false. It is impossible to perfectly control this image, but an approximation may be obtained between the respective intensities of the visual and actinic rays. This end is accomplished by adding certain coal-tar products to the emulsion, which render it sensitive to the yellow and orange rays. Nevertheless the emulsion is more sensitive to the violet than the yellow rays, and it is requisite, in order to equalise the sensitiveness of these rays that a medium be interposed in their course through the lens which is capable of reducing the power of the violet without interfering with the yellow rays. A thin piece of glass, ground flat on each side, the sides being perfectly polished and stained yellow has this effect. An Ilford No. 1 Isochromatic screen, placed either directly before or behind the lens

* When an "ordinary" photographic plate is mentioned, it is not intended to refer to the rapidity of the same, but to distinguish it from an orthochromatic one.



A CONSERVATORY.

admirably answers this purpose. Such a screen will, in general practice, be found to require double the exposure with Edward's or Lumière's Isochromatic plates. If Ilford Isochromatic plates are used with it the exposure should be increased three times.

Photographers who reside in India and other hot or humid climates will find that Isochromatic plates will not keep as well as ordinary ones. For their benefit the following methods of rendering ordinary plates orthochromatic is here described. The first of the two following processes is, however, protected in England by patents.

Any plate of medium rapidity having a film of hard gelatine, which is not liable to frill, may be prepared by either of the following methods.

Mix the following solutions :—

A. Preliminary bath.

Aqua ammonia	1 dram.
Water	7 ounces.

B. Colour sensatising bath.

Erythrosine	1½ drams.
Aqua ammonia	2 drams.
Water (distilled)	5½ ounces.

Immerse the plate, in the dark room using ruby light only, in bath A, and allow it to remain thoroughly covered for about three minutes, when it must be removed and allowed to drain for half-an-hour in absolute darkness, then plunge it in bath B and rock it gently (using only a very deep ruby light) 60 to 70 seconds. Enough of this solution should be used to thoroughly immerse the plate, and the same solution should not be used to bathe more than ten plates. The plates should be dried in a drying cupboard in darkness.

Plates sensitised by this process will not retain their good qualities more than a few days at the most. They will be very sensitive to yellow and orange rays, but not to red.

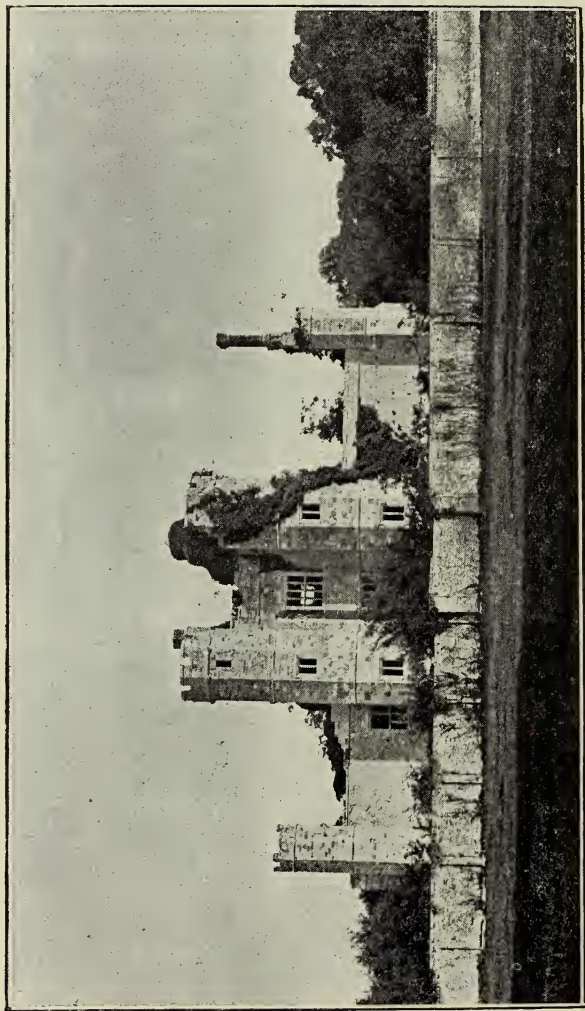
The following formula is that recommended by Mr. Ives, of Philadelphia. It renders the plates sensitive to red rays, the operations should therefore be carried out in darkness.

Dissolve

Cyanine	5 grains.
In distilled water	10 ounces.

Immerse the plates in this solution for one minute, and allow them to thoroughly dry, then rinse for one minute in running water, and again allow them to dry, when they will be ready for exposure. Plates treated by Mr. Ives' method will keep well for several months.

The dishes used for this solution, and also for the B bath should be of glass which is chemically clean.



TITCHFIELD CASTLE, HAMPSHIRE.

CHAPTER III.

EXPOSURE OF EXTERIORS.

IN many photographs in which high lights abut upon deep shadows, it will be seen that the high lights have spread laterally into the shadows. This is particularly noticeable in such objects as trees, or chimneys standing out against the sky; also in interiors where a halo surrounds the windows or objects reflecting bright light. This blurring of the lights arises from two causes, viz : (a) lateral reflection amongst the particles of silver salt contained in the emulsion, and (b) reflection between the bright surfaces of the glass called halation. The lateral reflection cannot be prevented, but as it is usually of an insignificant amount it may be disregarded. The reflection between the surfaces of the glass plate is of a much more serious character. Fortunately it is not very difficult to prevent, and for this purpose plates ground on the back have been placed on the market. These plates certainly minimise in a degree the encroachment of high-light, but do not prevent it. The most effective method of preventing halation is to use plates coated thickly with emulsion, and to back them in the following way, viz :— Cut a piece of dark (preferably black) carbon transfer paper, as used in autotype printing, a little smaller than the plate to be backed. Soak this for several minutes in a saturated solution of alum (about one ounce of alum to a pint of water) and, after draining off the superfluous moisture, brush the carbon side with a mixture of glycerine and water in equal proportions. The paper should be placed with the

carbon on the back of the plate and squeezed into optical contact with it by means of a soft rubber roller. This backing will remain moist for sometime and will be effective as long as it is wet.

Most photographic text books recommend the back of the plates to be painted with dark yellow or red pigment. This method has several serious disadvantages. It is extremely dirty to handle and difficult to wash off the back of the plate. Whereas the carbon paper can be easily stripped off, and used over again. The pigment backing is also of little use unless the plate is exposed before the backing becomes dry.

Having thus considered the preparation of the plate our attention must be turned to the use of the camera when photographing the exterior of a building. So-called correct perspective is not true visual perspective. To illustrate this it is only necessary to examine a photograph of a tall building, in which the camera during exposure has been pointed upwards, and the swing-back fixed at right angles to the bottom of the camera. It will be seen that the photograph of the building becomes considerably narrower towards the top and has the appearance of falling away from the perpendicular in a backward direction. This is called incorrect perspective—but it is almost exactly how the building would be seen assuming the observer to stand in a similar position to that of the camera, his line of vision being in the same direction as the axis of the lens. True visual perspective is therefore not in accordance with modern ideas of rendering of perspective in a photograph, or drawing—and rightly so, for all lines which are vertical in the building should, in order to appear vertical, be rendered in the photograph as such.

Correct perspective is obtained by placing the swing-back of the camera, however much the camera be tilted up or down, in a vertical position. A plumb level, or a substitute for it should be used to insure the back being quite vertical.

It will often be found advisable to raise the moveable front of the camera carrying the lens, thus reducing to some extent the excessive tilt of the camera that would otherwise be necessary.

It is often impossible to retreat far enough from a building to include the whole of it, or such portion as it is desired to photograph, while using a lens of longer focus than the longest dimension of the plate. Lenses having a short focus and capable of giving a wide angle of view are employed in such cases.

When using wide angle lenses, particularly when the camera front is raised, care must be taken that the bellows obstruct none of the rays on their course from the lens to the plate. To ascertain this, remove the focussing-screen and run the eye along the frame of the camera back, close to the margin of the aperture, when any obstruction caused by the bellows will be readily seen. Also see that the lens when raised, or lowered covers the plate to the corners, without cutting off any portion of the image. This difficulty may often be obviated by slightly swinging the lens board forward and bringing the lens nearer to the centre of the plate.

If one portion of the object is much further from the camera than another, the swing back may aid in focussing by having one of its sides brought nearer to the lens, and the operator may secure sharp definition with a larger stop than he could otherwise use. When focussing, not only should the covering power and depth of focus be observed with regard to the aperture of the lens, but the ground-glass should be examined all over and the focus adjusted midway between the relative distances required by the nearest and the furthest portion of the object about to be photographed.

Many photographers attempt too much at a time when photographing architectural elevations. It would be better if they concentrated their attention on certain features only,

and made a series of exposures on the respective details they wish to reproduce.

In confined positions the photographer cannot produce perspective work equal to the elevation drawings published in the architectural periodicals, nevertheless he has the means of doing much good work, both special and general.

John Ruskin says, in his *Stones of Venice*, "a power of obtaining veracity in the representation of material and tangible things, which, within certain limits and conditions, is unimpeachable, has now been placed in the hands of all men, almost without labour." The last three words are unfortunate, as no good photographic work can ever be executed without much labour, care and thought, although in the special branch of that science now under consideration no artistic training is requisite, but merely a thorough knowledge of photographic technique.

The camera should be placed about the same height from the ground as the line of vision, and not from a neighbouring window.

The hour of the day when the building is lighted to advantage should be chosen, so that the mouldings are clearly defined. It is advisable to make a preliminary journey to inspect the object before taking the camera, so as to note its aspect and at what hour of the day the best and most suitable contrasts of lighting may be secured.

The south may be found without the aid of a compass by holding a watch horizontally, so that the hour hand points to the sun. The position half-way between that point and the XII. on the dial is due south, *e.g.*, at 4 p.m. when the hour hand points to the sun, the II. on the dial is due south. Count forwards in the morning, backwards in the afternoon. Having found the compass bearing of any object intended to be photographed by the method described above, the hour when the sun will illuminate such object from the direction

desired may be seen by reference to the table* shewn in Figure 3.

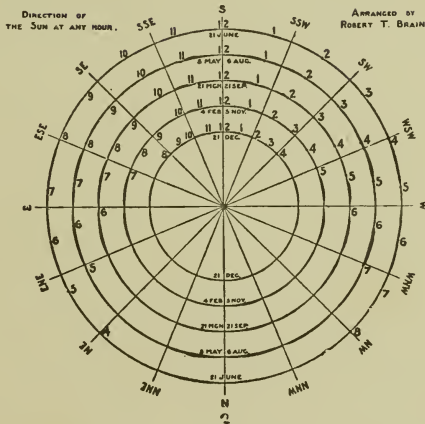


FIG. 3.

Exposure as well as the actinic (not the visual) intensity of the light varies not only with the hour of the day, but the month. It is both theoretically and practically impossible for any photographer, however experienced, to more than approximately gauge the correct exposure required to act upon the sensitive film to the degree desired. An exposure meter that is capable of measuring the actinic power of the light should be consulted when making each exposure, as although there is a certain amount of latitude allowable with every plate, there is only one exact period which can give the best result. Messrs. Hunter & Driffeld in their researches respecting exposure and development have proved irrevocably that the period of exposure invariably fixes the ratio of relative tones of contrast, which cannot be altered by so-called rational development.

* The author acknowledges the permission to reproduce this table kindly granted by his Publishers, to whom the copyright belongs.

The following table shews the relative (not necessarily the correct) duration of exposures to be given during the different months of the year and hours of the day.

MONTH.	LIGHT.	TO 11 A.M.				11 A.M. TO 2 P.M.				2 P.M. TO 4 P.M.			
		f/22	32	44	64	f/22	32	44	64	f/22	32	44	64
January, October and November	Sunlight ..	2½s	5s	10s	20s	1¼s	2½s	4s	10s	3s	6s	12s	24s
	Diffused light	3s	6s	12s	24s	1¼s	3s	6s	12s	3½s	7s	14s	27s
February, March and September	Sunlight ..	1½s	3s	6s	12s	1s	2s	4s	8s	½s	1s	2s	4s
	Diffused light	1¾s	3½s	7s	14s	1¼s	2½s	5s	10s	¾s	1½s	3s	6s
April, May and August	Sunlight ..	1s	2s	4s	8s	¾s	1½s	3½s	7s	1s	2s	4s	8s
	Diffused light	1¼s	2½s	5s	10s	1¼s	2½s	4½s	9s	1¼s	2½s	5s	10s
June and July	Sunlight ..	¾s	1½s	3s	6s	¾s	1½s	2½s	5s	¾s	1½s	3½s	7½s
	Diffused light	1s	2s	4s	8s	1s	1½s	3½s	7s	1¼s	2½s	4½s	10s
December	Sunlight ..	4½s	9s	18s	36s	3s	6s	12s	24s	12s	24s	48s	1¼m
	Diffused light	5½s	11s	22s	44s	4s	8s	16s	36s	14s	28s	46s	2m
NOTE: "s" stands for seconds; "m" for minutes.													

When the plates are backed, one-fifth to one-quarter more exposure should be given them to compensate for the light absorbed by the backing, which would otherwise be reflected back to the film and cause halation.

If there are objects moving between the camera and the building a small stop should be used in the lens, so that a

long exposure may be given and the moving objects thus removed from the plate. Always give a full exposure, and never under-expose, as an under exposed plate tends to give halation through prolonged development, and detail which is not impressed upon the plate cannot be developed by any developer however powerful. A plate slightly over exposed may be restrained in development and suffer but little from the excess of exposure.

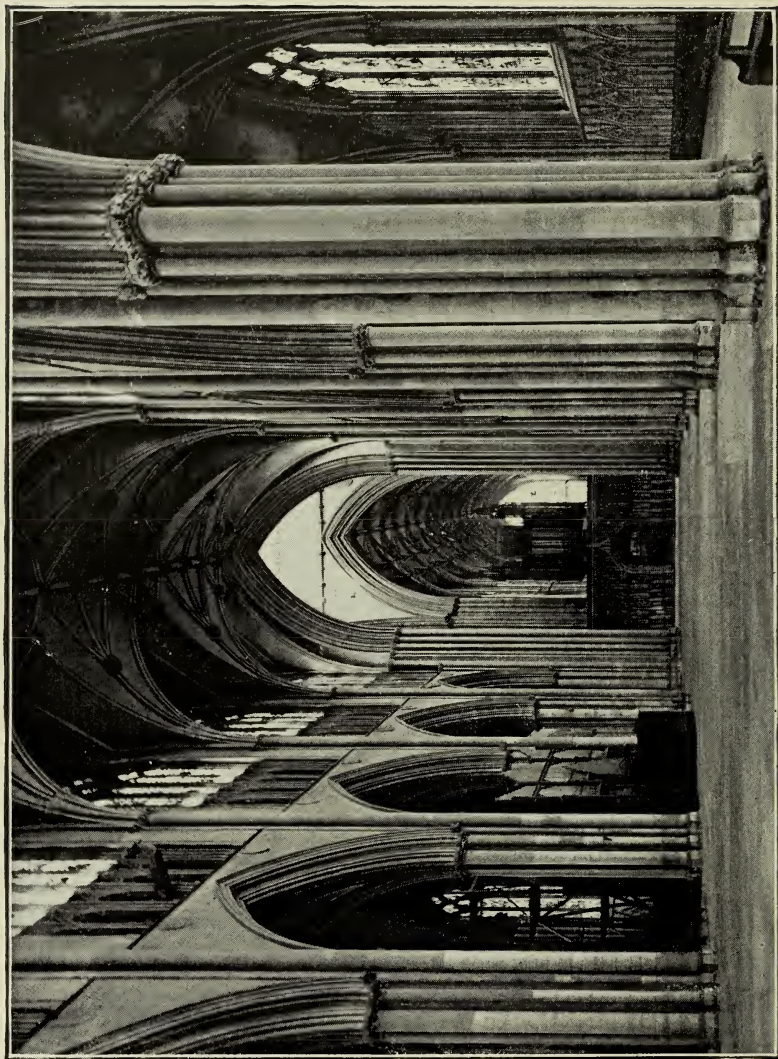
CHAPTER IV.

EXPOSURE OF INTERIORS.

THE remarks contained in the last chapter respecting perspective equally apply to photographing interiors. Much time may be profitably expended, and care exercised in selecting the point of view, and deciding upon the quantity of the subject to be included on one plate. In treating a church let the principal parts each have consideration. The nave, choir, screen, reredos, organ, old tombs, stained glass windows, and transepts all afford much suitable work. Note at what hour the objects are most effectively lighted, from what distance they produce the most pleasing perspective, and what other objects may, if also included upon the plate, aid by giving contrast, or assist by interpreting the size of the principal object. In this class of work the front of the camera may often with advantage be moved to one side, the position of the vanishing points being thus altered and a totally different rendering of the perspective accomplished.

A bright streak of light, caused by the sun shining through a stained glass window, may make an otherwise uninteresting subject beautiful by the contrasts which it introduces, if the position of the camera be well chosen.

The floors of churches and cathedrals are often slippery and the balls of rubber, mentioned in the first chapter, should be placed on the spikes of the tripod to prevent it slipping.



THE NAVE, YORK MINSTER.

If there are any people moving about a small stop should be placed in the lens and a long exposure given. It is however, not advisable to use a small stop, unless absolutely necessary. The sharp definition obtained by the small stop prevents the softening of the back-ground, an important feature in dealing with a screen or other similar object, which it is desired to bring into clear relief.

In domestic interiors, greater difficulties confront the photographer, though such subjects as entrance halls, stair-cases, dining-rooms, conservatories, etc., present ample scope for good work. The point of view must be carefully chosen, so as to avoid as much as possible very deep shadows. Large objects in the immediate foreground tend to demonstrate the forced perspective rendered by a wide angle lens. Round or geometrically shaped objects near the corners of the plate appear much distorted by it. It must be remembered that the corners of the plate are much further from the lens than is the centre, and therefore require longer exposure. To equalise the necessary relative exposure required by the plate, care should be exercised in arranging furniture and other objects by placing, when possible, dark objects so as to be projected on to the centre, and lighter ones on to the edges and corners. Lines may be too much broken up and perspective deliniated to a disadvantage if the camera is placed too near a corner of the room. Objects having an actinic colour should be placed in the shade, and those of a non-actinic hue in a bright light.

Such objects as table-tops, when near the camera, present the appearance of being too conspicuous if the camera is placed high. It should be raised and lowered until the best effect is produced upon the ground-glass.

Reflections on bright objects should be looked for, and they may be partially or wholly removed by moving or tilting the reflecting surface. Corks placed behind pictures will often accomplish this. Windows with venetian-blinds, not

within the range of the lens, provide a means of equalising the illumination of the room. The blinds should be let down and the laths turned horizontally so that they reflect light upwards.

The view through a window in front of the camera may be secured by covering the window on the outside with a curtain of black velvet or other dark substance the cover must remain during almost all the exposure, and be removed for a short time before completion.

It is a mistake to close doors without observing the pictorial effect obtained by leaving them open, as a glimpse through them, or through a partially curtained arch often improves and adds to the interest of a picture.

Before exposing the plate make sure that the alteration of of the position of furniture, etc., has not materially varied the usual aspect of the room.

Always expose for the darkest portions of the interior, and let the high lights take care of themselves. It is impossible to give a table of exposures that will answer on every occasion, but an exposure-meter should be used. The following table may prove useful as a rough guide, but the exposure must be increased according to the hour of the day, the table being calculated for noon during the different seasons of the year.

RELATIVE EXPOSURE TABLE, suitable for slow, or rapid isochromatic plates if used with a light yellow screen.				
Season of the year, the hour being noon.	Size of Stop.	Length of Exposure when light :		
		Bright.	Fair.	Dull.
		H. M.	H. M.	H. M.
Summer ...	F. 16	2½	5	8
	F. 22	5	10	15
	F. 32	10	20	30
	F. 44	20	40	1 0
	F. 64	40	1 20	2 0
Spring and Autumn	F. 16	4	8	10
	F. 22	7½	15	20
	F. 32	15	30	40
	F. 44	30	1 0	1 20
	F. 64	1 0	2 0	2 40
Winter ...	F. 16	5	10	15
	F. 22	10	20	30
	F. 32	20	40	1 0
	F. 44	40	1 20	2 0
	F. 64	1 20	2 40	4 0

The above table has been compiled from the notes taken of a large number of correctly exposed negatives, ranging over many years work.

CHAPTER V.

DEVELOPMENT.

It is exposure and not development, which decides the density of the negative, provided development be timed so as to produce true gradation of light and shade. In fact the developer has nothing whatever to do with the density of the negative, though it is true that the time required with differently composed developing solutions to produce a given density may vary, but when all the latent image has been oxidized, not only the density, but the amount of detail remain constant and the gradation unaffected.

As was first pointed out by Mr. Lyonel Clark, and proved by Messrs. Hunter and Driffild in their experiments with regard to density, the action of a certain amount of light acting upon a photographic plate is absolute, and any agent capable of developing the image so caused will show a fixed amount of reduction, though the time required necessary to accomplish this may vary considerably.

The author has for many years preferred Pyrogallol and carbonate of soda as a developer for both exterior and interior exposure, but, in order that he might speak with an unbiassed opinion on the subject, he has made a large number of experiments with almost all the developers that have been recommended, the result being to confirm his former preference. This developer, will therefore only be referred to. It should preferably be prepared in 10% solutions as described below, so that as many grains of the respective chemicals as may be required to compose the developing solution may be easily measured, ten minims of each solution contain (approximately) one grain of the solid.

The solutions are prepared as follows :

(a) Pyro solution (the true developer) :

Pyrogallol	1 ounce, avoirdupois.
Sulphite of Soda	4 ounces ,,
Citric Acid	1 drachm fluid.
Water to make	9 ounces, 1 drachm, fluid.

The soda is dissolved in about 6 ounces of hot water, and when this has become cold, the acid and the pyrogallol are added, water being added to make up to 9 ounces, 1 drachm.

(b) Carbonate of Soda solution (the accelerator) :

Carbonate of Soda (anhydrous) ..	2 ounces, avoirdupois.
Water to make	18 ounces, 2 drachms, fluid.

(c) Bromide solution (the restrainer) :

Bromide of Potassium	1 ounce, avoirdupois.
Water to make	9 ounces, 1 drachm fluid.

Different plates require differently composed developers, but the following may be taken as an average :—

Pyro	30 grains, <i>i.e.</i> 5 drachms, fluid.
Carbonate of Soda	100 grains, <i>i.e.</i> 1 drachm, 60 m.
Bromide	5 grains, <i>i.e.</i> 50 minims.
And water to 10 ounces.	

Mr. Alfred Watkins has proved by his experiments that the time of the appearance of half-tones of the image under development is an exact guide to the time required to complete the development under ordinary circumstances, the constitution of the developer being taken as a factor.* When the time of appearance is noted, and it is multiplied by a factor (varying with different developers) the quotient will be the total time requisite for development.

* *Camera Club Journal*, March, 1894; *Amateur Photographer*, and *British Journal of Photography*, 23rd February, 1894.

Alterations in the amount of alkali, sulphite, or bromide, or of the temperature of the developing solution (all within the limits found safe in practice) require no alteration in the multiplying factor when a pyro developer is used. With hydroquinone this is not the case, as the factor varies with the amount of bromide, higher factors giving greater contrasts than lower ones with it. Bromide with this developer lengthening the time of appearance of the image, much more than the total length of time required for development, and a lower multiplying factor is required if extra bromide be added.

There is no advantage in varying the quantity of alkali in the developer. With each developer there is a minimum quantity which is advantageous, below which the full effect of the developer is not exercised. If more than this minimum quantity be added it will quicken development, but produce no other effect, unless a great excess be employed, when chemical fog will result. Less alkali than the minimum gives the effect of under-exposure with a correctly exposed plate, or correct exposure with an over-exposed plate; hence the power to cope with over-exposure, in a limited degree. An excess of alkali will not correct under-exposure.

It is difficult, but not unimportant, to judge whether a negative suffers from incorrect exposure, or from inaccurate length of time of development.

Under-exposed negatives may be thin and fogged, or bright and clear with good contrast, but the gradation will be faulty and a lack of detail observable in the shadows. Over-exposed negatives may also be thin and fogged, or dense, but never clear with good contrast, the gradation will also be faulty, but no lack of detail will be present in the shadows.

From what has already been stated above it will be seen that an important control may be exercised over the gradations of a negative by the length of time which the developer has taken to produce it, a short development giving flat

or soft negatives, and a long development much greater contrast between the various tones. But it is the exposure that regulates the length of development, thereby regulating the gradation of the negatives, the modification of the developer having nothing to do with this.

It has been the author's practice in developing interiors to commence with a developer weak in pyro and bromide, and as soon as all the detail appears to increase these up to their normal strength. This method is not scientific, but when such difficult subjects as interiors have to be treated, it is as well to know whether or not the exposure has been correct as early in the development as possible, so that the length of development may be regulated, by the composition of the developer.

When development is considered complete the plate is well rinsed, and, if thought desirable, cleared of pyro stain by immersion in an alum bath (saturated solution) for two or three minutes. Alum, however, is not altogether a desirable friend, and if the plates have no tendency to frill a weak citric acid (1 in 80) is better. After the alum or acid the plate is again well rinsed, and then placed in the fixing bath for about ten or fifteen minutes. The strength of the bath should be about—

Hypsulphite of soda	1 ounce.
Water	6 ounces.

The plate may be examined from the back, and if every vestige of the white appearance is gone a few more minutes will complete the fixation. The hypo bath may be used for many plates, but it is not advisable to allow it to get very discoloured or overcharged with silver. The plate is now to be very thoroughly washed. This, after a preliminary rinse, may be done in daylight, and if in running water, one hour or even less, is sufficient ; or six or seven changes of water, made at intervals of about ten minutes, will be found to suffice. The plate, after washing, should be cleaned at

the back (the glass side) and placed in a rack, or leaning against a support to dry naturally. When dry it is ready for printing, or it may be varnished as a protection against the possible danger of damp silver paper, which causes red stains in the film almost impossible to remove.

The following is a good negative varnish, which can be easily prepared :—

Sandarac	..	..	..	..	..	4 ounces.
Oil of Lavender..	..	..	..	..	..	4 ounces.
Chloroform	..	..	..	..	..	5 drams.
Alcohol	..	..	..	..	..	25 ounces.

A fault, which occasionally occurs even in plates by the best manufactnrers, is an uneven thickness of film. The cause of this is that the plates have not been placed in a perfectly level position, while the emulsion has been setting. To counteract this fault, the negative should be coated upon the back with a mat varnish, composed as follows :—

Sandarac	..	..	..	..	..	90 grains.
Mastic	..	..	..	..	..	25 grains.
Ether	..	..	..	..	..	2 ounces.
Benzole	..	..	..	..	..	1 ounce.

When the varnish has set hard, take a large plug of cotton wool, moist with ether, and rub (lightly) the mat varnish from such parts of the negative as are denser than the rest.

CHAPTER VI.

INTENSIFICATION OF NEGATIVES, &c.

A NEGATIVE through incorrect exposure, or unskillful development may lack the opacity necessary for the production of good prints. This fault can be corrected by intensification, but the relative scale of densities cannot be varied in the negative.

Two methods of intensification are commonly employed, each of which has a distinct action, (a) by thickening the metallic deposit; and (b) by substituting different metal, having a more opaque colour.

Before any process of intensification is employed the negative must be freed from all trace of hyposulphite of soda. It being practically impossible to do this by washing it with water, the negative should be soaked in the following solution for half-an-hour, and then washed.

Peroxide of hydrogen ..	..	..	..	..	30 minims.
Water ..	..	..	..	..	10 ounces.

(a) *Intensification with silver.* This is one of the oldest and most satisfactory methods, and the result is permanent. The plate is immersed in

Pyrogallol ..	..	..	..	..	30 grains.
Citric Acid ..	..	..	..	..	20 grains.
Water ..	..	..	..	..	10 ounces.

After allowing it to soak for a minute, the solution is poured off into a measure and 20 to 30 minims of a twenty-grains to the ounce solution of nitrate of silver is added. This mixture is poured over the negative until sufficient density is obtained.

(b) *Intensification with Uranium.* The following method is recommended by Dr. J. M. Eder. A solution is made up according to the following formula:—

Nitrate of Uranium	..	..	..	..	30 grains.
Ferricyanide of Potassium	..	..	..	..	30 grains.
Water (distilled)	..	..	..	..	8 ounces.

The plate is placed in this solution, when the details in the shadows are first acted upon, then the half tones, and finally the high lights. It is important that the ferricyanide of potassium should be free from any trace of ferrocyanide. Crystals acted upon by light, dust, air, and certain gasses become coated with a layer of ferrocyanide, and they should, therefore, be washed by running water over them for a few seconds until they are quite clean and of a bright ruby colour before they are dissolved. If the solution is prepared some time before it is used, the ferrocyanide of the metal becomes precipitated, and filtration will remove it. Intensification with this solution should not be carried out in a bright light.

The intensifier most in use is a solution of perchloride of mercury used as a bleaching agent, the plate being afterwards darkened by reducing, by treating the deposit of mercury with sulphite of soda or ammonia. The results obtained by this process are not permanent. If, however, this method is employed care should be taken that the solution of mercury be acid, or the deposit formed by substitution will be deposited evenly over the negative, instead of according to the gradation of its densities.

Over-density of the negative is due either to over-development, or to over-forcing in development of an under-exposed plate. No treatment can make an under-exposed plate capable of producing good prints, but over-development of a negative may with advantage be reduced by soaking it for a few minutes in a freshly prepared hypo bath,*

* See page 33 for strength.

to which a few drops of a solution of ferricyanide of potassium (40 grains to the ounce of water) have been added. A reducing action will immediately begin, the action proceeding in proportion to the amount of ferricyanide present. If the action ceases before sufficient reduction has been effected pour the solution into a measure glass and add to it a few more drops of the ferricyanide solution, then pour the same over the negative. This may be repeated two or three times before the negative will become sufficiently transparent. After this treatment the negative must be thoroughly washed, as after fixing in a hypo-bath.

Local reduction (*i.e.*, reduction of parts only of a negative) may easily be performed by rubbing the parts which are too dense with a plug of cotton-wool dipped in alcohol. The rubbing must be fairly vigorous and prolonged, care being taken, however, that the film is not damaged.

Frilling and blistering. When the gelatine film leaves the plate at the edges, or blisters in the middle, the fact may be accounted for by one of the following reasons: (*a*) a too warm developing solution; (*b*) a too strong hypo bath containing an excess of alkali; (*c*) the temperature of the developer, alum bath, hypo bath, or washing waters differing from each other; or (*d*) very new plates prepared with soft gelatine. It occurs with some plates when developed with hydroquinone. In this case, if a solution of ferrocyanide of potassium, instead of bromide, be employed as a restrainer neither frilling nor blisters will appear. However, if the film has left the plate in places, soak the plate in a saturated solution of alum, fix and wash carefully so as not to tear the film, then place the plate in a tray and pour alcohol over it. Let it remain for about one minute or until the film has become smooth, remove the plate carefully, and allow it to dry, when the film will again take up its original position fast to the plate. The alcohol will evaporate quickly.

CHAPTER VII.

THE PLATINOTYPE PROCESSES.

PRINTS produced by the Platinotype processes may be of a grey-black or brown. The former are produced either by a hot or a cold bath, and the latter by a hot bath process.

The paper is purchased ready sensitized in sealed tin tubes which prevent atmospheric moisture from decomposing it. The tubes, after having been opened, should not be used for storing the paper unless the lid to the tube be secured with a strip of gummed paper. A piece of chloride of calcium should always be placed in the tube used for storage, as this will absorb moisture, and thus preserve the paper. If the chloride of calcium become soft, it must be replaced by a dry piece.

Hot bath process for black tones. The sensitive side of the paper (the yellow) is placed in the ordinary manner in the printing frame, and backed with a sheet of thin vulcanised India-rubber, or a thick pad of dry paper, to preserve the sensitive paper from damp.

The effect of damp is seen in want of vigour, a general muddiness of tone, and, where the sensitized paper has been exposed to its influence for some days, in the impaired purity of the whites.

The visible effect of printing is seen by the yellow tint of the paper becoming greyish where the light has acted upon it as in the shadows; the high lights of the print remaining unchanged.

The correct exposure (about one-third of that required with silver printing) is ascertained by inspection of the paper in a

rather weak white light in the usual manner. A little experience will enable the operator to determine the exposure very accurately.

As a general rule all parts of the picture, except the highest lights, should be visible when the exposure is complete. It is a good plan, if the negative be thin or lacking in contrasts, to varnish the edges of the negative with opaque varnish. The edges of the paper will then remain unchanged during the exposure, as no light can reach them, and thus render it more easy to estimate the depth to which a print has turned.

When examining prints in printing frames, care should be taken not to expose them unduly to light ; for the degradation of the whites of the paper, due to slight action of the light, is not visible until after development.

Damp paper gives a less visible image than dry, hence it is easily over exposed.

Care must be taken to preserve the paper after printing and before development from damp.

The developing solution is prepared as follows : Dissolve

Oxalate of Potash	..	..	..	..	1 lb.
In Hot Water	..	..	..	..	54 ounces.

This solution will keep indefinitely.

Development is affected by floating the printed surface of the paper for five or six seconds upon the developing solution, which may be conveniently contained in a flat bottomed dish of enamelled iron, heated by a spirit lamp, or gas stove. The temperature of the solution should be about 90° Fahr., though higher and lower temperatures may be used on occasion. Under-exposed prints require more heat than those which are over-exposed. To test the temperature, a cheap chemical thermometer may be placed in the developing dish.

The solution should be at least half-an-inch deep in the dish to float the prints without marking them with air bubbles. One end, and not the centre, should be first brought into contact with the solution. Lay one edge of the print upon the solution near the right-hand end of the dish ; then, with a sliding motion towards the left, lower the print with an even movement, until the whole of it is in contact with the solution, where it must remain until complete action has commenced. It may be raised from time to time in order to watch the progress of its development.

After the prints have been developed put the developing solution, without filtering, into a bottle for future use. Do not expose the bottle containing it to a strong light. As the solution becomes degenerated through use, it may from time to time be strengthened by adding some fresh solution to it.

Immediately development is completed each print as it is taken from the developing solution must be immersed face downwards in a solution of

Hydrochloric acid (s. g. 1.6)	..	..	..	1 ounce.
Water	..	..	..	60 ounces.

contained in a glass or porcelain dish. Prints should remain about ten minutes in this solution, and then be removed to a new bath for another ten minutes, and again into a third. Prints should not communicate to the last acid bath any tinge of colour.

The prints require a final washing in three or four changes of water. It is advisable to add a pinch of washing soda to the second washing water, to neutralize any acid remaining in the paper.

Hot-bath process for sepia tones. Paper prepared for sepia tones is treated in the same manner as that above described for the hot-bath Black process with the following exception.

To the developing solution add for each ounce one to two drams of the Platinotype Company's "Special Solution" supplied for this purpose; or the following developing solution may be used, viz :

Saturated solution of potassium oxalate	..	10 ounces.
Saturated solution of cupric chloride ..	..	1 ounce.
Oxalic acid.. .. .	..	1 drachm.

The developer should be of a temperature from 150° to 160° Fahr.

Granitine baths or dishes, carefully heated, are the best for sepia paper. An enamelled-iron dish which has once been used in developing sepia paper, should on no account be afterwards used in developing Black-tone paper. Sepia prints, unlike the Black, may be affected by light when in the acid-bath, the lights being stained and degraded. The prints at this stage, and during development, must be manipulated in a very weak light.

Black and sepia prints should never be cleared and washed together in the same dish.

Cold-bath (Black) process. This process differs from the hot-bath process above described only in the following respects: The developing bath is not heated, development is slower, and the developer is more diluted.

The developing solution is as follows :—

Oxalate of Potash	..	..	..	..	..	½ lb.
Water	..	..	..	..	..	54 ounces.

The paper for the cold-bath process is not damaged by a little moisture during printing, but it gives better prints if it be placed in a dark cupboard or other similar place for half-an-hour, or until the crispness begins to diminish, before placing in the printing frame. This paper should receive a full exposure, and with negatives that are thin, printing through green glass is recommended.

Warm tones may be obtained by using a weaker developing solution made slightly alkaline. The addition of acid to the developer gives cold tones.

Alkali should on no account be added in larger quantities than is just sufficient to turn blue litmus paper red. Ammonia is unsuitable: potash, soda or carbonates of these alkalies may be used.

The scum of the developer should be cleared off before development and the bath rocked to break up any scum that may be left.

CHAPTER VIII.

BROMIDE PRINTING.

THIS process has the great advantage of producing prints by artificial light such as gas or lamp-light.

The paper is purchased sensitized with a slow bromide of silver emulsion. It must only be handled in yellow or red light, as it is about as sensitive to white light as the average lantern plate.

The details of the process are as follows :—The sensitive emulsion side of the paper is placed next to the film of a negative in the printing frame, and exposed to artificial light. In the coloured light of a dark room some may find a difficulty in discovering which is the sensitive side of the paper. It will be observed, however, that each sheet of paper curls slightly at the edges, making the paper dish-shaped. The hollowed side is the sensitive side. In case the paper has been pressed quite flat, the film side may be easily detected by damping one corner at each side, when it will be recognised by its stickiness.

The time for exposure varies with the intensities of the light, the density and colour of the negative, and the distance of the latter from the source of light; the time increasing as the square of the distance. The negative being a good average one, about two seconds in a diffused daylight, or twenty seconds held one foot from an ordinary gas burner, will be found correct.

After exposure the print is developed and fixed like a negative.

The most suitable developer is the Ferrous-oxalate, though almost any other may be used. This developer is made as follows :—

A. Potassium oxalate	..	..	..	..	1 lb.
Hot Water	..	..	..	..	20 ounces.

This solution should have an acid reaction, which is best obtained by adding oxalic acid.

B. Proto-sulphate of iron	..	..	..	8 ounces.
Hot Water	..	..	..	20 ounces.

Rendered acid by adding sulphuric acid.

C. Bromide of Potassium	..	..	..	1 ounce.
Water to ..	..	..	..	10 ounces.

Solution A. should stand twelve hours before it is used.

To develop correctly exposed paper take of

Solution A.	..	..	..	..	4 ounces.
„ B.	..	..	..	..	1 ounce.
„ C.	..	..	..	..	30 minims.

After exposure the paper is placed in a clean porcelain or glass developing dish, film side uppermost, and the dish filled with clean water, which is then poured off, leaving the paper sticking to the bottom of the dish. The developer is then poured on, and the print is treated in the same manner as a negative during development.

Immediately the print is sufficiently developed it should be flooded with the following solution for ten or twenty seconds, the dish being rocked during this time.

Acetic Acid	..	..	..	..	1 drachm.
Alum (powdered)	..	..	..	..	2 ounces.
Water	..	..	..	..	30 ounces.

After treating the print with this acid bath wash in several changes of water, and fix in

Hyposulphite of Soda	..	..	..	2 ounces.
Water	..	..	..	20 ounces.

for a quarter-of-an-hour, when it must again be subjected to

washing in several changes of water or in running water for half-an-hour.

Yellowness of the whites is due to two causes, (a) insufficient acid in the clearing bath, or (b) insufficient washing between the clearing and fixing baths.

Under-exposure is recognised by the high lights being chalky, and without detail; over-exposure by a very black print, or the image may have a grey sunk-in appearance. Over exposed prints can be reduced by soaking in a weak solution of cupric chloride.

Bromide prints may be treated with platinum in such a manner, that the silver image be exchanged for one of platinum, their colour being changed from black to sepia. The prints should be much over printed, and after clearing, fixing and washing be immersed in the following solution :—

Perchloride of platinum	..	..	..	2 grains.
Hydrochloric acid	..	..	..	1 drachm.
Water	..	..	..	10 ounces.

When the substitution of platinum has progressed sufficiently, rinse the prints in two or three changes of water, and soak them in a weak solution of cupric chloride, and again wash them. The cupric chloride bath may be omitted if desired. Its purpose being to remove any silver that may be left in the prints.

Pleasing brown tones may be given to prints on bromide paper by toning them in a bath composed of equal parts of the following solutions :—

A. Nitrate of uranium	..	..	..	..	1 drachm.
Water	..	..	..	..	10 ounces.
B. Ferricyanide of potassium	..	..	..	..	1 drachm.
Water	..	..	..	..	10 ounces.

The prints must be well washed before toning, and the washing, after toning, should not be prolonged beyond a quarter-of-an-hour in running water. The tone of the prints

may be greatly modified by varying the proportions of the two solutions.

A polished surface may be given to bromide prints by placing them to dry, face downwards, on pieces of vulcanite or glass, which have had their surface sprinkled with French chalk and rubbed over with a tuft of cotton wool, the rubbing having been continued until all the chalk has been removed. When dry the prints will peel off with a highly polished surface.

When placing the print on the glass or other support, it is well to do so under water, so that all danger of air bubbles may be avoided.

If it is intended to mount the prints so glazed, pieces of paper should be pasted on the back of the prints while they are on the supports. This will prevent the moisture of the mountant penetrating to the glazed surface, and marking it, in a streaky manner. When the prints are dry they will leave the supports.

CHAPTER IX.

AUTOTYPE PRINTING.*

THIS process, otherwise known as carbon or pigment printing is extremely easy to manipulate. Presuming that the tissue (mounted on paper) has been purchased unsensitised, the author gives the following sensitising solution, being similar to that employed by him.

Dissolve

Bichromate of Potash ..	..	..	..	6 drams.
In Water (hot) ..	..	..	..	20 ounces.

When cold, filter, and add liquid ammonia, if the solution should be acid until it will turn red litmus paper blue. This solution will not keep fresh enough for use for more than three days.

Sensitising. The tissue, after having been cut into pieces of the required size, and steamed at the mouth of a kettle, is placed in a copying press or under a board with a heavy weight upon it, so as to thoroughly flatten it. Then it is floated on the sensitising solution for fully three minutes,* great care being taken that no air bubbles are present upon its surface. (It is best to immerse one end first, keeping hold of the opposite end, and to gradually lower it.

The sensitising solution should be quite cold, and never above 65° Fahrenheit, or the gelatine will run when the paper is being dried. In summer it is best cooled by adding ice. The film must now be treated with care, and kept from all light while drying. To dry the paper, lift it slowly from the bath and lay it face downwards upon a slab of clean plate

* An egg-boiler is useful to measure this duration of time.

glass (the Autotype Company recommend a zinc plate, but the author finds glass more suitable). Then rub all moisture from the tissue as far as possible. This can only be done with a moderate tissue, and should be done quickly, as the gelatine has a tenacious tendency. Next lay the tissue on a pad of blotting paper and leave it to dry thoroughly, which should take from eight to ten hours in a warm atmosphere.

This sensitive tissue will keep for a week if air and damp are excluded. This can be secured by placing a thick slab of glass in a printing-frame the size of the sheets, with a piece of india-rubber cloth (the same as used in platinotype printing) over it; then putting the tissues upon it face to face and afterwards adding another rubber sheet, and the back of the frame.

The tissue becomes more sensitive after it has been kept a day or two, and is in the best state for printing when it has been sensitised about three days, for then it will only require about half the exposure necessary for an average silver print.*

Printing. Much has been written about the chemical action which takes place during exposure, and many different theories have been propounded. Dr. Eder states† that a chromate of chromium is formed, and that the gelatine associated with this compound, in the part rendered insoluble in water by the exposure, is not changed in its chemical composition. The organic matter, therefore, which is oxidised at the expense of the chromium appears to remain soluble in water, and to be washed away. This explanation may possibly be the correct one, notwithstanding the more modern theories which have lately been advanced.

* In winter, however, it prints more rapidly, in comparison, than silver paper, owing to the fact that the maximum of the tissue's sensitiveness is in the blue green, while that of silver chloride is in the violet.

† Ueber die Reactionen der Chromsäure und der Chromate auf Gelatin, Gummi, Zucker, &c., Wien, 1878.

As no visible change in the tissue takes place during exposure an actinometer is rendered necessary, but a little practical experience will soon teach the operator the necessary duration for each negative. It must be borne in mind, however, that the exposed tissue if kept some time before development, undergoes a change. A thin negative presenting very marked contrasts will give the same effect as a very dense one, if the exposure be short, and the tissue be kept a day in the dark before development. It is the dampness in the atmosphere which causes this action.

From what has already been said, it will appear clear to the reader that the print must be developed from the back. To do this the support must be removed from the back, another one having been previously attached to the face, which will therefore give a reversed position, unless the tissue be again transferred.

The first step is to put what is termed a safe-edge round the negative. This is most conveniently done by pasting four strips of non-actinic paper on the back of the negative so as to make a complete frame round the image. If this frame were not used the edges of the carbon tissue would wash up during the subsequent development.

The negative is now placed in the printing frame and a piece of sensitised carbon tissue laid upon it. The exposure of this tissue must be judged by means of an actinometer as the image is practically invisible. Several forms of actinometers are made for this purpose, consisting of a graduated scale of tints superimposed on a strip of sensitised albumen paper. A trial print is made in silver and the actinometer is exposed at the same time. When the silver print is correctly printed the number of the actinometer square, which has *just become visible*, is noted, and taken as a guide for future exposures, for which it is only necessary to watch the actinometer. As the tissue gets older it requires slightly longer exposure; it remains in good condition for about

ten days after sensitising. The print having been removed from the frame, the next step is development.

Development.—(*Single transfer for reversed positives*). Place a tough sheet of paper, porcelain, or fabric (stretched in a frame), at the bottom of a clean dish and fill with water. Place the exposed tissue face downwards, in the same manner as in the chromate bath, so as to exclude effectually all air, then raise the support upon which the tissue is to be placed, so as to allow it to come into contact with the tissue, and raise both out of the dish. Place a sheet of rubber over them and rub the moisture away, remove the rubber and place several sheets of blotting paper in its place, and set a board and weight over them. Let this remain at least ten minutes, after which place them in water at about 100° Fahr., when the old support will float off in a few minutes. If it does not do this easily, draw the fingers over it a few times. Should it still refuse to strip, a few drops of hydrochloric acid added to the hot water, will remove it.

The tissue must then be placed under a tap running with hot water, and all the insoluble portions of the gelatine washed away, leaving the finished print.

All this must be done in the dark room, or the tissue will become insoluble.

Double Transfer. A slab of zinc should be employed as the support on which to transfer the exposed tissue.

The image is developed as in single transfer.

After development, the final support (preferably rough drawing paper) is prepared by floating it upon a solution of

Gelatine (soft)	..	..	..	..	..	2 drams.
Chrome alum	..	..	..	..	..	15 grains.
Water	..	..	..	..	..	8 ounces.

And afterwards hanging it up by one corner to dry. When quite dry place it in contact (under water) with the developed

print, in the same manner as the single transfer was placed upon its support, and when nearly dry, under pressure, place it in the sun or in a warm, dry, atmosphere until it leaves the zinc plate.

It will be found an advantage to print from the support side of a film negative, and by this means avoid the extra trouble of double transfer.

CHAPTER X.

PRINTING ON GELATINO-CHLORIDE PAPER.

THIS paper is coated with a gelatine emulsion containing silver chloride and other salts. It may be printed out in the same manner as ordinary sensitised albumenised paper, or may be partly printed out, and afterwards developed.

Printing out. The prints should remain in the frames until they have become a little darker than is required in the finished prints. After leaving the frames the prints should have the excess of silver washed away by immersing them in two or three changes of water for two or three minutes, and then toned and fixed in the same way as silver prints on albumenised paper. Combined toning and fixing baths have been recommended by some workers, but as it is unsafe to rely upon the permanency of prints thus finished, and unless they are subsequently fixed in a hypo bath, there is nothing to be gained thereby.

The following toning solutions* will be found to work satisfactorily.

For cold tones. Sulphocyanide bath. Owing to the softening action of Sulphocyanide on Gelatine it is necessary to pass the prints through an Alum bath previous to toning. After the prints have been washed in three changes of water they should be immersed in the following bath for ten minutes :

Alum	..	..	..	..	..	..	½ ounce.
Water	..	..	..	..	..	..	20 ounces.

Thoroughly wash after the alum bath for 5 minutes in running water.

* These formulæ are recommended by the Eastman Co. Ltd.

TONING BATH.

Stock Solution A :

Sodium Acetate	..	..	..	..	600 grains.
Water	..	..	..	..	20 ounces.
Gold Chloride	..	..	..	..	15 grains.

Stock Solution B :

Ammonium Sulphocyanide	..	..	..	..	50 grains.
Water	..	..	..	..	20 ounces.

For use. Take of A 2 parts, B 2 parts, and water 4 parts.
Allow to stand an hour before using.

The prints must be kept in motion in this bath or uneven toning will result. When they are sufficiently toned transfer them to a salt bath composed of

Common Salt	..	..	..	..	1 ounce.
Water	..	..	..	..	32 ounces.

The prints should be well washed and then fixed in the hypo bath given on page 33. After they are fixed they should be washed for half-an-hour in running water or for two hours by constantly changing the water.

In warm weather, or if the prints show a tendency to frill or blister, they should be soaked for a few minutes in a saturated solution of alum and again thoroughly washed.

For warm tones. Use the following Platinum bath :
Stock Solution :

Potassium chloro-platinite	..	..	..	..	5 grains.
Citric Acid	..	..	..	..	40 „
Sodium Chloride (Salt)	..	..	..	..	40 „
Water	..	..	..	..	20 ounces.

Tone to a dark brown or chocolate colour (not to a black).

For brown tones. Acetate bath :

Stock Solution :

Sodium Acetate	..	..	..	..	150 grains.
Gold Chloride ..	..	..	..	..	5 „
Water ..	..	..	..	..	40 ounces.

Tone to a chestnut brown only. Short Stop and Fixing operations are the same as for Sulphocyanide bath.

Developing gelatino-chloride paper. The following are the Eastman Company's directions :

Print one-fourth to one-twentieth the depth required for the regular toning process. The print ought to show faint detail in all but high lights. Immerse the dry print directly in the developer given below.

A.	Hydrochinon ..	..	..	..	..	$\frac{1}{2}$ ounce (avd.)
	Sulphite Soda ..	..	..	..	..	$\frac{1}{2}$ „
	Potassium Bromide ..	..	..	..	..	1 „
	Ammonium Bromide..	..	..	..	..	2 „
	Water ..	..	..	..	..	64 „
B.	Caustic Soda ..	..	..	..	..	$\frac{1}{4}$ ounce (avd.)
	Water ..	..	..	..	..	16 ounces.
C.	Tannic Acid ..	..	..	..	..	8 grains.
	Water ..	..	..	..	..	1 ounce.

To develop take

No. A	..	..	..	..	..	5 ounces.
No. B	..	..	..	..	..	1 ounce.
No. C	..	..	..	..	..	1 dram.

The print will, when first put in the developer, fade away to a pale yellow ; then will slowly develop up to a point showing about as much detail as and about one-half the strength of a finished print, but remaining yellow. If the developer works too fast dilute with water.

Develop until print shows all the detail and about half the strength required in a finished print ; this will take ten to thirty minutes.

As soon as the prints are developed transfer them into the acid bath :

Acetic Acid	..	..	..	..	..	3 drams.
Water	..	..	..	..	..	1 gallon.

and after washing them in several changes of water they may be toned in any of the toning baths above-mentioned.

If the prints continue to develop in the toning bath, too much alkali (solution B) has been used in the developer. The prints will appear to strengthen by reason of the change of colour in toning, but they ought not to increase in detail.

The exact point to which the printing is carried does not seem to make very much difference ; so long as the print is under printed, it can be brought up by the developer.

Development is best done by ordinary lamplight without a yellow shade.

Prints made by the above process are rather more brilliant than those fully printed out.

More sulphite in A tends to make softer prints.

Solution C requires a drop of carbolic acid if it is desired to keep it indefinitely. The tannic acid is used only to harden the gelatine.

Drying. The print can be dried by laying it upon blotting paper face upward, but it must not be left between blotting paper ; or it may be suspended by one corner and allowed to dry spontaneously.

Glazed Surface. This may be obtained by squeegeeing the prints, as soon as they are taken from the last washing water, face downward on a support as described on page 46. If a mat surface is desired the support should be ground glass.

CHAPTER XI.

MOUNTING PRINTS.

MR. LYONEL CLARK in his book, entitled "Platinum Toning," states that he has had an opportunity of examining a good many old photographic silver prints, dating from 1855 and earlier, and that he has frequently remarked the marvellous difference in stability between those prints that have been mounted in an album and those that had been simply trimmed and kept in portfolios. The action of light appeared to have had nothing to do with it, as one kind had not been more exposed to light than the other. The cause of the fading was undoubtedly due to the mountant. The fading referred to was not a yellowing of the high lights (which was rarely, if ever, met with in plain paper prints, it being a special attribute of albumen), but a general loss of intensity, and in some cases almost entire disappearance of the image. In prints which had been mounted by the edges only the destruction of the image accurately followed those portions of the prints touched by the mountant.

The author commends the above remarks to his readers, and although the paste employed has often much to answer for, with respect to the fading of prints, there is much to be learnt from Mr. Clark's statements.

The two following mountants may be regarded as the most safe to employ; the former, being most suited to prints on albumenised paper, or other *small* prints, the latter, to large prints on stiff paper:—

1. *Starch Mountant.* Put a tea-spoonful of pure white starch in a large cup, with sufficient cold water to cover it. After it has soaked for five minutes, pour boiling water

into the cup until it is almost full. Stir well with a spoon, and allow the solution to cool before using.

2. *Glue Mountant.* Shred a quantity of clean light glue and soak it in sufficient clean water to cover it for some hours. Pour off the water and replace an equal quantity of fresh water. Dissolve by heat. After thinning down to the proper consistency with warm water, it is ready for use.

The prints, having been previously trimmed, should be soaked in water for a few seconds and then placed between blotting paper, and subjected to pressure for a short period, when they will be ready to receive the mountant.

Place each print, in turn, face down, on a flat board, and with a stiff brush apply the mountant solution round the edges. Place the print on the mount, the two top corners being allowed to touch first, so that no difficulty may be experienced in placing the print true with the edges of the card. When the print is in its place, cover it with a piece of glazed paper and pass an india rubber roller over the whole, in order to expel any air bubbles from between the the print and its mount.

After the excess of mountant, has been squeezed out, and wiped away with a clean moist cloth, place the print under pressure to dry, so as to prevent the mount from warping or cockling.

Bromide prints should not be immersed in water before mounting, but slightly moistened with a sponge. Plate sunk india-tinted boards show such prints as these and platinotype off to the best advantage.

Dry albumenised prints may be easily uncurled by drawing them, face downwards, against a soft table cloth, under a paper-knife.

Burnishing. The temperature of the Burnisher should not exceed 170 degrees. If a Bar Burnisher is used the surface

of the print must be lubricated. This is best done by rubbing it with a piece of flannel or cloth which has been made greasy by the application of ordinary Castile soap.

Mounting Gelatino Chloride Prints. The prints may be mounted with starch paste in the ordinary manner, but if it is desired to mount them with an enamelled surface, the prints should first be backed with backing paper then brushed over with very thin, pure, well-filtered glue and placed in position on the mount.

APPENDIX.

WEIGHTS AND MEASURES.

TROY WEIGHT.

Pound.		Ounces.		Pennyweights.		Grains.		Grams.
1	=	12	=	240	=	5,760	=	373·25
		1	=	20	=	480	=	31·10
				1	=	24	=	1·55
						1	=	·06

APOTHECARIES' WEIGHT.

(The pound, ounce, and grain are the same as in Troy weight).

lb.		℥		ʒ		℥		gr.		Grams.
Pound.		Ounces.		Drams.		Scruples.		Grains.		Grams.
1	=	12	=	96	=	288	=	5,760	=	373·25
		1	=	8	=	24	=	480	=	31·10
				1	=	3	=	60	=	3·89
						1	=	20	=	1·30
								1	=	·06
								(15½	=	1·00)

AVOIRDUPOIS WEIGHT.

Pound.		Ounces.		Drams.		Grains. (Troy).		Grams.
1	=	16	=	256	=	7,000	=	453·60
		1	=	16	=	437·5	=	28·35
				1	=	27·34	=	1·77

LIQUID MEASURE.

60 Minims	...	...	1 drachm (f.3).		
8 Drachms	...	...	1 ounce (f.3)	=	1.73 cub. ins.
20 Ounces	...	...	1 pint (o)	=	34.68 „
8 Pints	...	...	1 gallon (c)	=	277.25

The Imp. Gallon is 10 lbs. Avoirdupois of pure water.

The Pint. is approximately $1\frac{1}{4}$ lbs.

VOLUME—LIQUID.

			Gills.	Pints.	Cub. In.
4 Gills	=	1 pint	...		
2 Pints	=	1 quart	...	8	
4 Quarts	=	1 gallon	...	32	= 8 = 231
1 gal. (cj)	=	8 pts. (Ovij)	=	160 ozs. (f.3, 160)	= 1,280 drms.
				(f.3, 1,280)	= 76,800 minims.

USEFUL WEIGHTS.

One Shilling weighs	...	...	...	87 $\frac{1}{2}$ grains.
Half-penny and Three-penny piece	...	...	...	$\frac{1}{4}$ ounce.
Florin and Sixpence	...	...	...	$\frac{1}{2}$ „
Three Pennies	...	...	...	1 „
Four Half-Crowns and One Shilling	...	...	...	2 „
Four Florins, four Half-Crowns, and two Pennies	...	...	...	4 „
48 Penny and Three penny piece	...	...	...	1 lb. Avoirdupois.

FLUID MEASURES.

THE cubic centimètre, usually represented by “c. c.,” is the unit of the metric system for liquids. It contains 16.896 minims. The weight of this quantity of water is one gramme. Hence it will be seen that the cubic centimètre and the

gramme bear to each other the same relation as the drachm for solids and the drachm for fluids, or as the minim and the grain.

1 cubic centimètre	=	17 minims	(as near as possible).
2 cubic centimètres	=	34	„ „
3	„	=	51 „
4	„	=	68 „ or 1 drachm 8 minims.
5	„	=	85 „ „ 1 „ 25 „
6	„	=	102 „ „ 1 „ 42 „
7	„	=	119 „ „ 1 „ 59 „
8	„	=	136 „ „ 2 drachms 16 „
9	„	=	153 „ „ 2 „ 33 „
10	„	=	170 „ „ 2 „ 50 „
20	„	=	340 „ „ 5 „ 40 „
30	„	=	510 „ „ 1 ounce 0 drachm 30 minims.
40	„	=	680 „ „ 1 „ 3 drachms 20 „
50	„	=	850 „ „ 1 „ 6 „ 10 „
60	„	=	1020 „ „ 2 ounces 1 „ 0 „
70	„	=	1190 „ „ 2 „ 3 „ 50 „
80	„	=	1360 „ „ 2 „ 6 „ 40 „
90	„	=	1530 „ „ 3 „ 1 „ 30 „
100	„	=	1700 „ „ 3 „ 4 „ 20 „

THE CONVERSION OF THE METRIC SYSTEM INTO ENGLISH WEIGHT.

ALTHOUGH a gramme is equal to 15.4346 grains, the decimal is one which can never be used by photographers; hence in the following table it is assumed to be $15\frac{2}{5}$ grains, which is the nearest approach that can be made to *practical* accuracy:

1 gramme	=	$15\frac{2}{5}$ grains.
2 grammes	=	$30\frac{4}{5}$ „
3 „	=	$46\frac{1}{5}$ „
4 „	=	$61\frac{3}{5}$ „ or 1 drachm $1\frac{3}{5}$ grain.
5 „	=	77 „ „ 1 „ 17 grains.
6 „	=	$92\frac{2}{5}$ „ „ 1 „ $32\frac{2}{5}$ „
7 „	=	$107\frac{4}{5}$ „ „ 1 „ $47\frac{4}{5}$ „

8 grammes =	123 $\frac{1}{5}$ grains	 or	2 drachms	3 $\frac{1}{5}$ grains.
9 ,, =	138 $\frac{3}{5}$	,, ...	2 ,,	18 $\frac{3}{5}$,,
10 ,, =	154	,, ...	2 ,,	34 ,,
11 ,, =	169 $\frac{2}{5}$	,, ...	2 ,,	49 $\frac{2}{5}$,,
12 ,, =	184 $\frac{4}{5}$	,, ...	3 ,,	4 $\frac{4}{5}$,,
13 ,, =	200 $\frac{1}{5}$	,, ...	3 ,,	20 $\frac{1}{5}$,,
14 ,, =	215 $\frac{3}{5}$	,, ...	3 ,,	35 $\frac{3}{5}$,,
15 ,, =	231	,, ...	3 ,,	51 ,,
16 ,, =	246 $\frac{2}{5}$	,, ...	4 ,,	6 $\frac{2}{5}$,,
17 ,, =	261 $\frac{4}{5}$	,, ...	4 ,,	21 $\frac{4}{5}$,,
18 ,, =	277 $\frac{1}{5}$	,, ...	4 ,,	37 $\frac{1}{5}$,,
19 ,, =	292 $\frac{3}{5}$	,, ...	4 ,,	52 $\frac{3}{5}$,,
20 ,, =	308	,, ...	5 ,,	8 ,,
30 ,, =	462	,, ...	7 ,,	42 ,,
40 ,, =	616	,, ...	10 ,,	16 ,,
50 ,, =	770	,, ...	12 ,,	50 ,,
60 ,, =	924	,, ...	15 ,,	24 ,,
70 ,, =	1078	,, ...	17 ,,	58 ,,
80 ,, =	1232	,, ...	20 ,,	32 ,,
90 ,, =	1386	,, ...	23 ,,	6 ,,
100 ,, =	1540	,, ...	25 ,,	40 ,,

An easy way to convert grammes into English is to divide the sum by 4, which gives the equivalent in drachms very nearly thus:—

Grammes.		Drachms.	Ozs.	Drachm.	Grains.
100	÷ 4 =	25	= 3	. 1 +	43

The above weights are those usually adopted in formulæ.

All chemicals are usually sold by Avoirdupois Weight, in which there are 437 $\frac{1}{2}$ grains to the ounce.

The Precious Metals, such as Silver and Gold, are sold by Troy Weight, containing 480 grains to the ounce.

METRIC SYSTEM OF WEIGHTS AND MEASURES.

AND THEIR EQUIVALENTS IN ENGLISH.

1 Cubic Centimètre	=	17 minims nearly.
$3\frac{1}{2}$ „ „	=	1 drachm.
28·4 „ „	=	1 ounce.
50 „ „	=	1 ounce, 6 drachms, 5 minims.
100 „ „	=	3 ounces, 4 drachms, 9 minims.
1000 „ „	}	= 35 ounces, 1 drachm, 36 minims.
or 1 litre,		
= to 61 cubic inches		

MEASURE OF LENGTH.

Millimètre	=	·03937 inch.
Centimètre	=	·39371 „
Decimètre	=	3·93708 „
Metre	=	39·37079 „
Inch	=	2·5399 centimètres.
Foot	=	3·0479 decimètres.

MEASURES OF SURFACE.

Square inch	=	6·4513 square centimètres.
Square foot	=	9·2899 square decimètres.

MEASURES OF WEIGHT.

Milligramme	=	·0154 grain.
Centigramme	=	·1543 „
Decigram	=	1·5432 „
Gramme	=	15·4323 grains.
Kilogramme	=	15432·3488 „

THERMOMETERS.

Freezing point 0 Centigrade ; 0 Réaumur ; 32 Fahrenheit.

Boiling point 100 Centigrade ; 80 Réaumur ; 212 Fahrenheit.

The readings of one scale may be converted into those of either of the other two by the following formulæ. T° indicates degrees of temperature.

Cent. to Réau.

$$\frac{4}{5} T^{\circ} C = T^{\circ} R.$$

Réau. to Fahr.

$$\left(\frac{9}{4} T^{\circ} R\right) + 32^{\circ} = T^{\circ} F.$$

Cent. to Fahr.

$$\frac{9}{5} T^{\circ} C + 32^{\circ} = T^{\circ} F.$$

Fahr. to Cent.

$$\frac{5}{9} (T^{\circ} F - 32^{\circ}) = T^{\circ} C.$$

Réau. to Cent.

$$\frac{5}{4} T^{\circ} R = T^{\circ} C.$$

Fahr. to Réau.

$$\frac{4}{9} (T^{\circ} F - 32^{\circ}) = T^{\circ} R.$$

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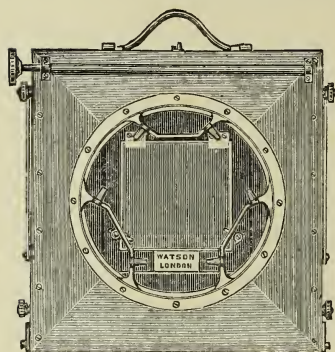
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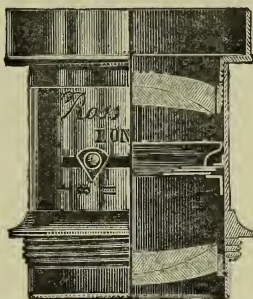
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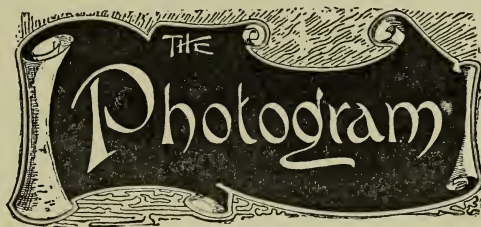
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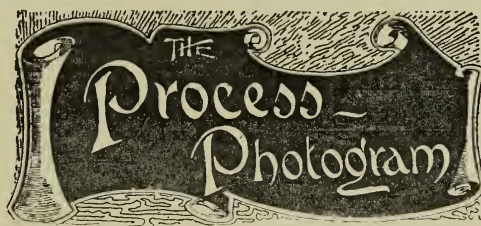
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